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SYNCHRONIZED STORAGE CONTROL APPARATUS FOR A MULTIPROGRAMMED DATA PROCESSING SYSTEM

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ABSTRACT OF THE DISCLOSURE

A multiprogrammed data processing system wherein control apparatus controls the transfer of information between a working store and a sequential access circulating auxiliary store and wherein the control apparatus further retrieves control information from the working store in synchronism with the time of access to information stored in the auxiliary store and maintains the control information in an order corresponding to the time of access for controlling the transfer of information during successive cycles of circulation thereby implementing the flow of information at the speed required by the system.

BACKGROUND OF THE INVENTION

This invention relates to data processing systems and more particularly to storage control apparatus for controlling the transfer of information between the working and auxiliary stores of a data processing system.

A data processing system including a computer for alternately executing a series of programs which are completely or partially located in a quick-access working store is said to be multiprogrammed. One form of multiprogrammed data processing system comprises at least one computer, at least one small capacity quick-access working store, a relatively large capacity circulating auxiliary store and a plurality of peripheral control units each coupled to at least one peripheral device. In such a multiprogrammed data processing system, the series of programs are executed by the computer as controlled by an operating system which is a collection of programs that are executive or supervisory in nature and provide overall coordination and control of the total data processing system. The series of programs also include subject programs which are application oriented programs to perform various data processing jobs providing results required by users. In multiprogrammed data processing systems required to execute a large number of programs, the quick-access working store capacity is too costly to be large enough to contain all of the operating system programs, subject programs, data to be processed and data which is the result of processing. Consequently, only the programs and data most frequently used or currently in process are normally located in working store and the remaining programs and data are located in a relatively large capacity slow-access circulating auxiliary store. As programs and data stored in auxiliary store are required to be executed or processed by the computer, the information must be accessed and transferred to the working store at a speed compatible with the data processing capabilities of the computer.

It is necessary to maintain a continuous supply of programs or parts of programs and data for the working store if the operating system is to be able to have a plurality of different subject programs in process simultaneously. For operating systems to use the equipment complement

of the entire data processing system most efficiently, operating systems must call for the right mix of programs for movement to working store. The operating system must also call for movement of processed data to auxiliary store. The operating system schedules the running of all programs by maintaining in an order list, the order in which programs are to be run and providing for a calling sequence for initiating transfer of information between working and auxiliary stores when needed. Frequently, the calling sequence initiates a series of transfers encountering lengthy waiting times in transferring information due to waiting for sequential access to information in the circulating auxiliary store.

Generally, control of information movement between working and auxiliary stores in the system described comprises expeditiously accessing data to be processed, data which is the result of processing, and the programs or parts of programs providing the required data processing functions between the working and auxiliary stores and controlling each of the working and auxiliary stores to provide efficient storage and retrieval of information being transferred. Such control is effected by one of the peripheral control units. Auxiliary stores normally function as one of a plurality of peripheral devices being controlled by a peripheral control unit.

All data processing operations are performed on operand words under control of instruction or control words of programs. An operand word represents a unit of information to be processed or information which is the result of processing. An instruction word, hereinafter referred to as an instruction, designates a particular operation for the computer to perform. A control word designates a particular type of peripheral device operation or data transfer function for a peripheral control unit to control. Each control word comprises portions called "address fields" which represent specific locations in working and auxiliary stores that contain instruction, control or operand words.

The locations in a circulating auxiliary store are normally circumferentially disposed storage areas termed sectors on a surface of a circulating member. The sectors are successively located by circumferential position about an axis of circulation and are thus sequentially accessible in their order of location relative to a starting sector accessed at the start of each cycle of circulation.

The peripheral control unit gains access to working store locations by means of control words which are stored in working store and transferred to the control unit in response to a computer executing a particular instruction of an operating system calling sequence. Once the control unit receives a control word it performs autonomously to retrieve and execute a string of additional control words to provide for data access and transfer operations. The operating system has previously stored the string of control words in the working store in the order of execution. The computer is now free to continue with its high speed execution of subject programs.

Prior art peripheral control units provide for transfer of information between a working and circulating auxiliary store by controlling the execution of a string of control words termed "data control words." At the completion of the execution of each string of control words, the circulating store is disconnected from the control unit and the control unit disconnected from the system. Only the computer can initiate another transfer of information by executing an instruction which results in transferring a first control word of a string to the control unit. The control unit responds to the first control word to connect the circulating store to the control unit and to signal the details of control information for controlling a specified storage operation at a specified sector of the circulating